EXECUTIVE SUMMARY

This Executive Summary and the attached three volumes constitute the application by Amoco Oil Company (Amoco) for renewal of its existing National Pollutant Discharge Elimination System (NPDES) permit No. IN0000108 (the "existing permit"). The existing permit, issued February 28, 1990, authorizes Amoco to discharge treated process water, once-through cooling water, and stormwater from four point sources into the waters of the State of Indiana, as described below.

This Executive Summary contains a brief description of the materials contained in each volume. Volume I contains the formal paperwork required as part of the NPDES permitting process, including Form 2C and a summary of the analytical results of Amoco's extensive testing program. Volume II demonstrates that a mixing zone is an appropriate tool for implementing Indiana water quality standards into the renewed NPDES permit and contains supporting hydrodynamic and biological information. Volume III uses the information from Volumes I and II to propose limits for the discharge of treated effluent.

BACKGROUND

Amoco owns and operates a petroleum refinery located on approximately 1700 acres in Whiting, Indiana, near the southern tip of Lake Michigan. The refinery employs approximately 1650 people and produces a variety of products, including gasoline of all grades, diesel fuel, heating fuel, jet fuel, and lubricating oils. The refinery processes a maximum monthly average of approximately 410,000 barrels of crude oil per day to produce these products.

The refinery discharges three types of water: treated effluent; once-through cooling water; and stormwater. First, the refinery discharges, as a long term average, approximately 13 million gallons per day (mgd) of treated effluent through Outfall 001 into Lake Michigan. The treated effluent originates from water used in the plant, recovered groundwater, and most of the stormwater from the site, all of which have been treated in the refinery's wastewater treatment plant (WWTP). Second, the refinery discharges approximately 120 mgd of once-through cooling water through Outfall 002, also into Lake Michigan. Third, the refinery intermittently discharges the balance of its stormwater through Outfalls 003 and 004 into the Lake George Branch of the Indiana Harbor Ship Canal. While all four outfalls are covered by the NPDES permit, Volumes II and III focus primarily on Outfall 001.

Prior to discharge through Outfall 001, the refinery's water is treated at an advanced biological WWTP, which occupies twenty acres and includes a grit chamber, oil/water separators, dissolved air flotation, an activated sludge plant and final filtering processes. The treatment plant is operated 24-hours a day, 365 days per year, and is managed by over thirty employees, six of whom are Indiana-certified wastewater treatment operators. The WWTP operates very efficiently, as evidenced by its excellent NPDES permit compliance record. In fact, the effluent meets human health safety-based drinking water standards, even prior to mixing with the Lake Michigan waters.

Amoco's Outfall 001 is regulated under two fundamentally different programs. First, the effluent is subject to technology-based limits applicable to all refineries nationwide. These technology-based limits are known as Effluent Limitations Guidelines (ELGs), and are found at 40 CFR 419 and at 327 IAC 5. Amoco's WWTP includes technologies beyond those required

by the ELGs, and the resulting effluent quality is generally superior to that mandated by the regulatory requirements. The technology-based limits are included in Amoco's existing permit and are not affected by Amoco's request for a mixing zone.

Second, Amoco's effluent is subject to Indiana water quality standards ("WQS") under 327 IAC 2-1. The program includes standards specific to Lake Michigan dischargers, some of which are found at 327 IAC 2-1-6(j) and referred to as the "6(j)" standards. WQS specify the acceptable concentration of a given substance in a receiving water that allows the designated uses of the water body to be attained. The WQS are converted into source-specific limits called water quality-based effluent limitations (WQBELs), which are then incorporated into a NPDES permit. In 1990, Indiana adopted numerical WQS which must be converted to site-specific WQBELs and incorporated, for the first time, into Amoco's renewed permit.

Volume I

Volume I contains the required technical data for this permit application. It includes Form 2C, which is to be submitted with all permit applications for industrial discharges into the waters of the United States. Form 2C instructions require sampling and analyses of each of Amoco's four outfalls. Amoco conducted this comprehensive sampling and analysis program during its current permit period. A summary of the results of this extensive testing program, as presented in Form 2C, characterizes Amoco's effluent. In addition, Form 2C summarizes the effluent parameters, as reported on monthly discharge monitoring reports from April 1991 to April 1994.

Volume I provides the data necessary to calculate the technology-based and water quality-based limits that apply to Amoco. Volume I also contains process unit throughputs, process factors, and size factors to assist the permit writer in calculating the generic ELGs into Amoco-specific limits based on the configuration of the Whiting refinery. In addition, Volume I contains "Pollution Prevention Progress," a document which summarizes ongoing pollution prevention practices at the Whiting refinery.

Volume II

Volume II contains a scientific demonstration that a mixing zone is an appropriate tool for implementing Indiana's 1990 Water Quality Standards as they apply to Amoco's discharge of treated effluent. A mixing zone is an area contiguous to a discharge where the treated effluent mixes with the receiving waters. WQS do not apply within the mixing zone; the standards are met at the edge of the mixing zone.

The use of mixing zones by the United States Environmental Protection Agency ("USEPA") has been in place since the 1960s. Hence, there are numerous technical reports, computer models and field study methods available to delineate mixing zones. In the recently promulgated federal Water Quality Standards, 40 CFR 131, Subpart D, the applicability of mixing zones is recognized. The USEPA has also issued many guidance manuals, some within the past eighteen months, which address the determination and use of mixing zones. These include recently updated core documents such as the 1991 Technical Support Document for Water Quality-based Toxics Control, the 1993 Training Manual for NPDES Permit Writers, and the 1993 Water Quality Standards Handbook.

It is important to note that Amoco is not seeking a mixing zone for any substances that bioaccumulate, nor is Amoco seeking to adjust any technology-based limits as a result of the mixing zone proposal. Amoco is only seeking a mixing zone for non-bioaccumulating substances regulated by the Indiana WQS, including the 6(j) standards.

Water quality standards, including the Indiana WQS, are based on criteria defined by three factors necessary to protect the designated use of a water body:

- magnitude of exposure,
- duration of exposure, and
- frequency of exposure.

The criteria consider both the acute (or short-term) effects and the chronic (or long-term) effects on aquatic life. A separate set of criteria have been developed for Lake Michigan to address drinking water quality.

Acute criteria are based on protecting the most sensitive species from acute effects and are expressed as Acute Aquatic Criteria (AAC). For instance, Indiana's AAC for chlorides is 860 mg/L as a one-hour average concentration, not to be exceeded more than once every three years on average.

By contrast, Chronic Aquatic Criteria (CAC) are derived to protect the most sensitive species from chronic effects and are expressed as a four-day average concentration. For example, the Indiana CAC for chlorides is 230 mg/L, as a four-day average, not to be exceeded more than once every three years on average.

As interpreted by the USEPA and stated in the Indiana WQS, the AAC and CAC, due to their time and exposure elements, are to be met in the receiving water, rather than at the end

of a discharge pipe (327 IAC 2-1-6 and 2-1-9). Mixing zones must be designed to prevent short term exposure to concentrations exceeding the AAC and long-term exposure to concentrations exceeding the CAC.

As summarized in Volume III, the Lake Michigan 6(j) standards should be applied at the edge of Amoco's mixing zone, rather than at its outfall. The 6(j) standards were promulgated in 1967 to protect drinking water supplies. Monitoring of water quality to compare to the 6(j) standards is performed thousands of feet from shore at points where drinking water is taken from the Lake and not at the end of a discharge pipe. Since the adoption of the 6(j) standards, the Safe Drinking Water Act (1974) and the Federal Water Pollution Control Act (1972) have been implemented, superseding the intent of the 6(j) standards. Nonetheless, the 6(j) standards remain in the Indiana rule and must be addressed.

As demonstrated in Volume II, Amoco's treated effluent meets 6(j) standards within 500 feet of the discharge pipe, and it meets the federal human health safety-based drinking water standards at the end of the pipe. The proposed mixing zone will be thousands of feet from the nearest drinking water intake and will not impact the intake. Since the mixing zone will not contribute to levels above the 6(j) standards at a drinking water intake, it is appropriate to apply the 6(j) standards at the edge of the proposed mixing zone.

Mixing zone procedures are well established in Indiana and nationwide. Indiana's rule concerning mixing zone procedures, found at 327 IAC 2-1-4(b), is consistent with the more detailed federal guidance. The state rule provides that a permit applicant seeking a mixing zone

must demonstrate the following:

(1) the dilution ratio;
(2) the physical, chemical, and biological characteristics of the receiving body of water;
(3) the physical, chemical, and biological characteristics of the waste effluent;
(4) the present and anticipated uses of the receiving body of water;
(5) the measured and anticipated effects on the receiving body of water;
(6) the existence of the impact in any spawning or nursery areas of any indigenous aquatic species;
(7) any obstruction of migratory routes of any indigenous aquatic species; and
(8) the synergistic effects of overlapping mixing zones or the aggregate effects of adjacent mixing zones.

327 IAC 2-1-4-(b)(1) - (8)

Volume II addresses each of these mixing zone criteria. Addressing these criteria calls on two different disciplines, hydrodynamics and biology. Amoco's hydrodynamic and biological studies, as well as the results reached by the experts in each discipline, are described below.

Hydrodynamics

A hydrodynamic investigation involves a study of the physical properties of mixing. Amoco previously demonstrated that its existing Outfall 001 provided significant mixing through the dispersion created by its current discharge configuration. Nonetheless, Amoco is proposing to install a multi-million dollar diffuser to provide additional assurance that compliance with the Indiana WQS will be maintained. A diffuser is a structure engineered to enhance mixing by discharging effluent at high velocity.

Amoco has designed a submerged high-rate multiport diffuser that reduces the size of the proposed mixing zone and increases achievable dispersion. The treated effluent would be pumped at high velocities through a 3,500 foot pipe and discharged through small ports, evenly

spaced over the last 90 feet of the pipe. The diffuser clearly establishes rapid and immediate mixing within a small area.

To determine the dispersion ratio achieved by the proposed diffuser, Amoco researched historical records, conducted its own field measurements, and consulted with widely recognized experts. The data gathered were entered into an EPA-endorsed computer model used to project mixing (CORMIX2, developed at Cornell University by Dr. Gerhard Jirka).

The total mixing zone (TMZ) encompasses the area where mixing is rapid due to the high-energy multiport diffuser and the somewhat larger area where natural ambient diffusion drives further mixing. The CORMIX2 model helps to identify the edge of the TMZ and to conservatively estimate the amount of dispersion achieved at that point. Based upon the results of the CORMIX2 data, Amoco has proposed, as a mixing zone, a circle within a 500-foot radius of the diffuser. Within this zone, the effluent is dispersed by at least a 77:1 ratio. As shown by field studies and computer modeling, a mixing zone can be delineated that meets the objectives of small size and rapid mixing. The 77:1 dispersion in the proposed mixing zone demonstrates that all 1990 Indiana WQS and all Lake Michigan standards will be met within a 500 foot radius of the diffuser.

Biology

In addition to the mixing hydrodynamics discussed above, Amoco conducted a biological assessment of the present discharge location and the proposed diffuser site. The biological assessment compared bottom-dwelling, free-floating, and attached aquatic communities from within the dispersion area in the vicinity of the existing discharge to those outside the dispersion area. These species were collected, identified, and counted because they are the most sensitive

aquatic communities. The structure and biologic processes of these communities, such as photosynthesis, were also compared using standard ecological techniques. Most comparisons showed no difference between the organisms within the present dispersion area and those outside the dispersion area. Where differences were observed, different community structures were attributed to physical and habitat differences typical of the southern Lake Michigan beach zone. For example, the naturally sandy bottom in this area of Lake Michigan prevents establishment of most bottom-dwelling species. The overall findings from the biological assessment are that the present discharge has not adversely affected aquatic life or the designated uses of the receiving water. With a submerged high-rate diffuser, the dispersion effects are enhanced, further minimizing the exposure time for organisms.

The hydrodynamic studies and biological assessment, taken together, demonstrate compellingly that Amoco's proposed mixing zone will not cause harm to human health or aquatic life. In fact, reducing the magnitude, duration and frequency of exposure by using a submerged high-rate diffuser makes Amoco's proposed mixing zone more protective of human health and aquatic life than the existing discharge. Therefore, under Indiana law, Amoco is eligible for a mixing zone as part of its NPDES permit renewal.

VOLUME III

Volume III presents the rationale for, and derivation of, proposed draft limits for the renewed NPDES permit for Amoco's Outfall 001. The proposal uses the effluent characterization data in Volume I and the mixing zone demonstration in Volume II.

Draft permit limits are developed in three stages. First, historical compliance with the current permit limits must be evaluated. Anti-backsliding provisions require that new permit limits be no less stringent than the existing permit limits. Second, a set of limits must be developed using the technology-based ELGs for petroleum refineries. Third, USEPA and IDEM procedures are used to develop water quality-based effluent limits (WQBELs). The ultimate draft permit limits are the most restrictive, representative, and valid numbers which can be derived from among current limits, technology-based limits, and WQBELs for each parameter.

Volume III reviews Amoco's current permit limits and the technology-based limits that are applicable to the Outfall 001 discharge. Based on historical performance, the WWTP has achieved compliance with the existing permit limits. Furthermore, Amoco's existing permit limits are equivalent to, or more stringent than, the calculated technology-based limits. Since the new permit limits can be no less stringent than existing permit limits, Amoco's existing permit limits would carry over to the new permit.

With respect to WQBELs, USEPA and IDEM have defined methods to derive permit limits from water quality standards (WQS). Effluent quality is projected by a determination of whether the concentration of a constituent in the effluent has a reasonable potential to cause or contribute to an excursion from the Indiana WQS in the receiving water. If there is a reasonable potential that the final concentration of the constituent in the receiving water will exceed the WQS, then a WQBEL for that constituent must be developed.

Volume III, using the Form 2C data, shows that WQBELs are required only for a few parameters: chlorides, sulfates, total phosphorus, total dissolved solids (TDS) and ammonia. For those five parameters, a wasteload allocation (WLA) assessment must show that the

discharge will not contribute to an excessive loading to the receiving water, taking into account impacts from accumulated loadings by multiple sources. The WLA identifies the maximum effluent concentration of a constituent in a point source discharge that the receiving water can assimilate without endangering the achievement of WQS (as described in the IDEM Office of Water Management OWM-1 guidance) .

Long-term monitoring of natural background concentrations of constituents in the south end of Lake Michigan demonstrates that:

- Concentrations of these five parameters are less than the Indiana criteria;
- The designated uses of Lake Michigan under Indiana criteria are being attained; and
- Additional assimilation capacity exists in the south end of Lake Michigan.

Volume III sets forth a site-specific WLA for Outfall 001, using procedures and concepts presented in IDEM's WLA for the Grand Calumet River - Indiana Ship Canal and USEPA's 1991 Technical Support Document for Water Quality-based Toxics Control. This WLA is integrated with Amoco's proposed mixing zone, reflecting the installation of a multiport diffuser. The WLA applied Lake Michigan 6(j) standards at the edge of the TMZ, which is consistent with the 1966 scientific application of the 6(j) standards and their Indiana regulatory history from 1967 to the present, as reviewed in detail in Volume III.

Using IDEM OWM-1 guidance, the limiting WLA values were translated into WQBELs. Finally, the WQBELs were compared to current permit limits to ensure that the more stringent limit is proposed in the draft permit. These limits are presented as monthly average and daily maximum conditions.

CONCLUSION

Amoco has thoroughly researched the historical background, rationale, and goals of the state and federal water quality programs. Amoco also consulted with engineers and scientists to perform hydrodynamic studies aimed at determining whether the present discharge configuration could be improved. These analyses showed that sufficient mixing was being achieved by the current Outfall 001. Amoco then requested that its experts evaluate the effects of installing a diffuser in conjunction with its request for a mixing zone. After thorough study, the experts designed a submerged, high-rate diffuser that would further enhance the dispersion ratio and provide even more rapid and immediate mixing in an even smaller area.

In conjunction with its hydrodynamic studies, Amoco brought together chemists, biologists, and limnologists to examine the biological effects of its current discharge on the receiving waters of Lake Michigan. These studies demonstrate that there is no difference between sensitive aquatic organisms inside and outside the current dispersion area, indicating that the present discharge is protective of the environment. The scientists were then asked to consider whether a submerged high-rate multiport diffuser would provide an additional level of assurance that human health and aquatic life would not be harmed if Amoco's request for a mixing zone was granted. The scientists agree that a mixing zone with a submerged high-rate diffuser would be even more protective of the designated uses of the receiving waters.

This application includes the results of Amoco's exhaustive studies and provides well-supported evidence for the proposed permit renewal. It allows IDEM's permit writers to make informed decisions based on sound science. Using the information submitted in this application,

along with the federal and state laws and guidance documents already in place, IDEM can renew Amoco's NPDES permit with a mixing zone that will not cause harm to human health or aquatic life.